National Aeronautics and Space Administration

# The DEEP Chamber

## Simulating Lunar and Martian Dust Environments

goddard technology

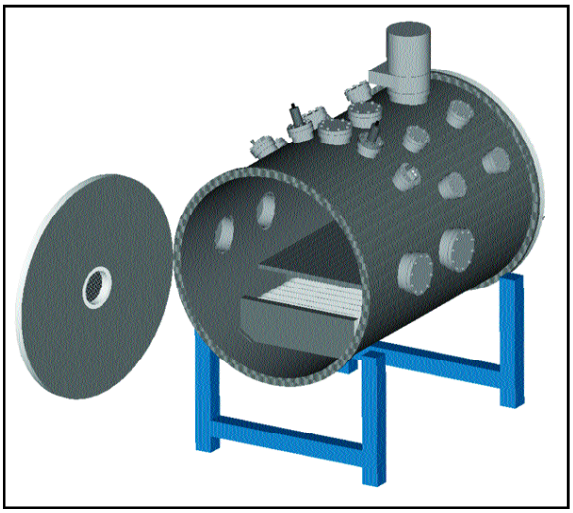
### About the Technology

Goddard's new Dust Environmental Effects Particle (DEEP) Chamber will give scientists and engineers the capability to test ground-based hardware in simulated lunar and Martian dust environments. The DEEP chamber will be a critical tool for characterizing the effect of lunar and Martian dust on spacecraft surfaces, including degradation-sensitive mechanisms, instrument surfaces, microshutters, optics, solar arrays, and thermal control and other special coatings. It also will give scientists a venue for testing their theories on how dust travels and levitates, particularly on the lunar surface.

### Significance of the Technology

Though unique, DEEP capitalizes on lessons learned from an existing dust chamber used by Goddard's Sample Analysis at Mars (SAM) instrument team, which is using a much smaller chamber to expose and test valves and filters to a Martian dust simulant. New exploration requirements, however, dictated that a much larger facility become available to test instruments and other larger components.

As a consequence, Goddard's new facility – measuring 1.2 meters in diameter and 1.8 meters in length – is significantly larger than complementary dust facilities operated at other NASA centers. Because of its size, it will be capable of accommodating a variety of flight hardware, from instruments and large components to spacesuits.



*This is a rendering of what the DEEP chamber will look like once it is operational.*

### Benefits of the Technology: At-A-Glance

- Larger size accommodates everything from components to flight hardware and spacesuits, which makes it unique among NASA's other dust chambers.
- Versatile design allows researchers to add capabilities and testing modes, which allows for more customized evaluation.
- Convenient, on-site location encourages testing, reducing the risk of hardware failures in the harsh lunar and Martian environments.

*See reverse side*

# DEEP

## Technology Origins

Seeing the need for a larger, more robust dust chamber, Goddard technologists used Internal Research and Development funding to design a chamber that could handle a diverse set of experiments, both at atmospheric pressures and in a vacuum.

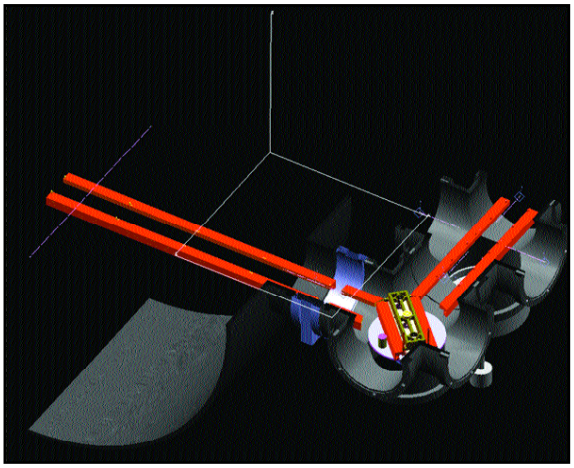
When completed, the cylindrical-shaped chamber will come equipped with external ports to accommodate manipulators, lasers, detectors, and other non-vacuum-compatible laboratory equipment. On the inside, the chamber features several vacuum-compatible mechanical systems to distribute the dust. It also is equipped with systems that simulate the lunar dust-charging environment and solar exposure. As a result, the chamber is ideal for studying and testing:

- Dust-charging mechanisms, dust-transport theories, and plasma effects
- Dust mitigation, removal techniques, and special coatings
- Dust-related light scattering
- Durability of thermal coatings in the Martian and lunar environments
- Abrasion and degradation of materials
- Flight hardware in a dust environment
- Solar effects on contaminated materials and components
- Spacesuit materials and components

## Enhanced Capabilities

The chamber's highly versatile design allows technologists to add new capabilities. Among those is a Lehigh University-designed payload translation table that will easily slide instruments and components inside the chamber.

Another modular addition being developed is a trolley system (below) capable of transporting small samples from the dust environment of the main chamber to an integrating sphere located outside the chamber, where reflectance measurements can be made.



## Looking Ahead

The chamber's customers are expected to include the NASA Engineering and Safety Center, the Exploration Technology Development and Constellation programs, the Goddard lotus dust-mitigation coating team, and the Goddard Sciences Exploration Directorate.

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